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REMOTE CONTROL APPARATUS

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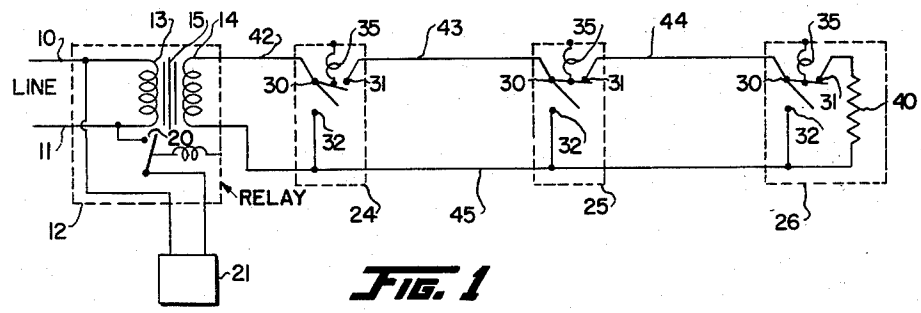


FIG. 1

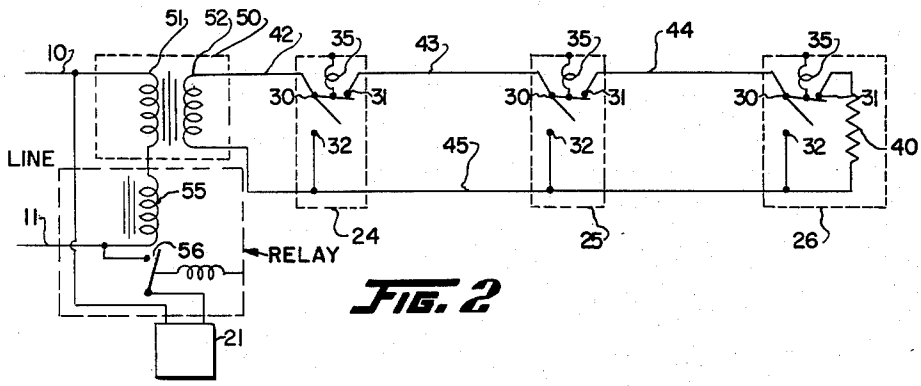


FIG. 2

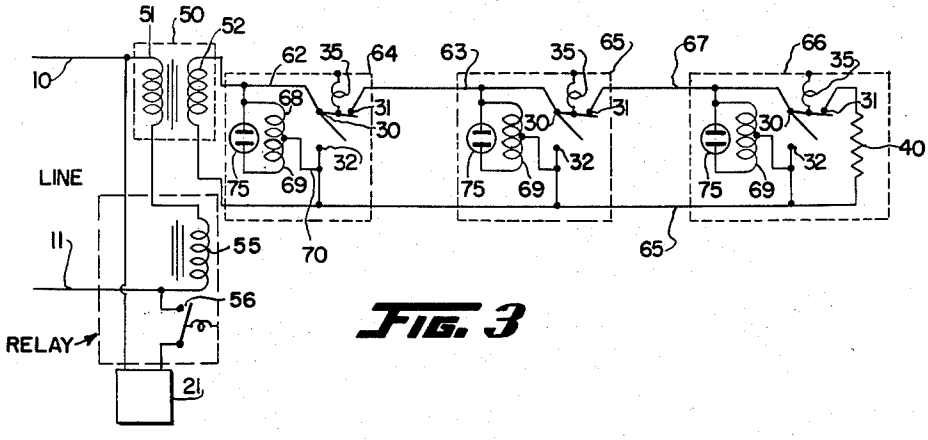


FIG. 3

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REMOTE CONTROL APPARATUS

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My application relates to a remote control apparatus and more particularly to an improved remote control circuit particularly adapted for lighting control.

Remote control switching apparatus and in particular apparatus which uses low voltage control circuitry is known and has been applied to various applications including lighting control. Complexity of circuitry from a cost and installation standpoint has generally precluded widespread use of the same, however. The present invention is directed to a simplified low voltage remote control apparatus which utilizes a minimum number of parts and a minimum number of low voltage conductors for remote connection to provide a simplified wiring arrangement which reduces initial cost and cost of installation. It is therefore an object of this invention to provide an improved low voltage remote control apparatus. Another object is to provide an arrangement of this type including simplified indicating equipment at switching points for apparatus. These and other objects of this invention will become apparent from the reading of the attached description together with the drawings wherein:

Figure 1 is a schematic circuit diagram of one embodiment of my invention,

Figure 2 is a schematic circuit diagram of a second embodiment of the invention, and

Figure 3 is a schematic circuit diagram of a third embodiment of the invention.

My improved remote control apparatus as shown schematically herein specifically applied to lighting control circuits of the low voltage type with a plurality of remote switching stations but it should be understood that any type of remote device may be controlled with a similar arrangement. As shown in Figure 1, line voltage or the main power source is adapted to be supplied across conductors 10 and 11 to a relay device indicated generally by the block 12. This relay including a primary winding 13 and a secondary winding 14 mounted on a core structure is indicated schematically at 15 which is designed to operate as a transformer relay in a conventional manner. The primary winding 13 is directly connected to the energizing source or high voltage source 10 and 11 and the relay includes a switching arrangement or switch contacts indicated at 20 which are adapted to connect a remotely positioned device such as a light source 21 to the line conductors 10 and 11 for energization of the same. In this improved control circuit, the plurality of remotely positioned switching means or switches are shown at 24, 25 and 26. Each switching means or switch includes two closure circuits as evidenced by the contacts 30, 31 and 32, the contact element 30 being of the double bladed type and movable between stationary contacts 31 and 32. The switches are equivalent to a single pole double throw type unit which is normally biased to a circuit closure positioned for the contacts 30 and 31 through a suitable biasing means such as a spring indicated at 35. Each of the remote switching circuits have the same contact arrangements and are identically numbered and disclosed with the exception of the switch

26 or the last switch in the circuit, which will include in addition a small bleed resistor or impedance element indicated at 40 and contained in the last switch location. As disclosed in Figure 1, the secondary winding 14 is connected through a conductor indicated at 42 to the normally closed contact 31 of the first switch 24 in line 42 and from its associated stationary contact in the normally closed position through a conductor 43 to the similar position in the succeeding switch 25 and through a conductor indicated at 44 to the switch 26. The bleed resistor or impedance 40 is connected across the switch contacts 31 and 32 for the last switch in line which is across the winding through a circuit which is completed through a conductor 45 to the opposite side of the secondary winding 14. In this arrangement, operating any one of the switches 24, 25 or 26 to the second circuit closure position as evidenced by contacts 30 and 32 for any switch position will effectively short circuit the secondary winding 14 to operate the transformer relay in the well known manner. This will reflect a change in impedance in the secondary winding, establishing a current therein, and will set up in the core structure 15 a magnetic flux by means of which a movable part of the relay may be operated to operate the switch mechanism 20. Since the details of the relay are conventional, they are omitted herein for simplicity. A momentary closure of one of the switches will operate the transformer relay and upon release of the same a series circuit is made for the secondary coil through the contacts 31 and 32 of each of the switches and through the impedance element 40 and conductor 45 which will carry sufficient current to the secondary winding to maintain the relay in an energized position but which is not of sufficient magnitude to direct flux through the core structure 15 to initiate the operation of the relay contacts. This circuit for the secondary winding may be broken at any one of the switches by opening any one of the contacts 30, 31 to open the secondary circuit allowing a change in flux flow through the core structure of the transformer relay to move the switching means to a non-operative position. In this arrangement, the low voltage conductors 42, 43, 44 and 45 require a two wire circuit which permits a simplified low voltage wiring arrangement with ease of installation and low cost. The use of the transformer relay in this arrangement with its own hold-in circuit eliminates necessity of more complex relay switching circuit to maintain the establishment of the remote circuit after it is initiated. While there are shown only three switching positions, it should be recognized that any number of switching units may be employed. In this embodiment, indication of the condition of energization of the remote device may be obtained by utilizing additional contacts from the transformer relay and connected directly to the high voltage line.

The second embodiment of the invention as shown in Figure 2, utilizes a separate transformer and a conventional relay, the transformer being shown at 50 as including primary windings 51 and a secondary winding 52. Serially connected to the primary winding 51 of the transformer 50 is a relay energizing winding 55 whose core structure details are omitted for simplicity. It will be recognized that any conventional relay may be utilized herein and that the relay will include a switching contact such as is indicated at 56 which connect the remote device 21 to be controlled across the source of power or conductors 10 and 11. In this circuit also the remote switching devices 24, 25 and 26 are utilized, the device 26 having the bleed resistor or impedance 40 included in parallel with the stationary contacts thereof to complete a series shorting circuit for the secondary winding 50 of the transformer which is connected by the conductors 42, 43, 44 and 45 to the sec-

ondary winding. In this embodiment the transformer relay has been replaced by the separate transformer and relay but the secondary or low voltage circuit is identical with the embodiment of Figure 1. The small transformer in the circuit will normally have a low resistance coil as its primary coil which is series connected to the relay coil, the relay coil also being wound to have an appropriate voltage current characteristic compatible with the transformer. When connected to across the line conductors **10, 11**, the primary impedance of the transformer is high and the transformer rides the line with excitation current only and with a small voltage across the relay coil which is insufficient to pull it in. When the secondary winding of the transformer is shorted, it reflects as a drop in impedance in the primary winding so that the current flowing therein results in a much lower voltage drop across the primary winding. The supply voltage from lines **10, 11** being constant results in an increased drop across the relay coil **55**. The total impedance for the primary circuit is less, and hence more current will flow from the line supplying the power dissipated by the shorted secondary circuit. The increased drop in the voltage across the relay coil is sufficient to operate the relay to cause it to pull in. When the switch is released at any one of the remote switching positions, the bleed resistor or impedance **40** at the end of the switch string leaves enough secondary current to adjust the relay voltage to a point where it will cause the relay to hold in but also such that the relay voltage is low enough so that it will not pull in directly if the switching operation has not been initiated by one of the switches **24—26**. In this embodiment, opening of the secondary circuit at the normally closed contacts of the **30, 31** of the switches **24—26** will disconnect the bleed impedance from the secondary winding causing a change in reactance in the transformer and a resulting change in voltage drop across the relay coil **55** which will tend to drop out the relay.

The embodiment shown in Figure 3 of the drawing is similar to that of Figure 2 in that it includes a separate transformer in series with the relay coil but differs therefrom in the inclusion of a small transformer and indicating light at each of the control stations and the contact **56** is normally closed as will be further described. The secondary winding **52** of the controlling transformer **50** is connected through conductors **62** and **65** to the switch station **64** which again includes the single pole, double throw switching unit formed of contact elements **31, 32** and **30**. In addition, a small auto transformer winding indicated at **68** having a tap at **69** is connected at one extremity to the conductor **62** and from the tap **69** through a conductor **70** to the conductor **65** and contact element **32**. In parallel with the entire winding **68** is an indicator light **75** which is connected to the extremities of the winding **68**. If desired, this switch indication apparatus may be included at only one or a few of the stations but it is shown herein at the stations **64, 65, 66**. The switching stations **65, 66** include the similar switch elements as in the before mentioned embodiment which are connected to one another in a parallel circuit through conductors **63, 67** and **65**. The station **66** representing the last station in the line includes the bleed resistor element **40** which operates in a manner similar to that described in the embodiment of Figure 2. The operation of this embodiment is substantially identical to that of the embodiment **2** in that operation of any of the switches to a circuit closure position or a circuit contact of elements **30, 32** for any of the stations will effectively short the secondary winding **52** of transformer **50** reflecting a change in impedance in the primary winding and hence a change in the voltage drop across the primary winding to increase the voltage drop across the relay coil causing it to pull in. The release of the switch at any of the stations **64, 65** and **66** after closure of the contact elements **30, 32** as in the preceding embodiment does not drop out the relay coil **55** but rather sufficient current flow through the bleed resistor **40** will allow sufficient current to flow through the secondary winding **52** to adjust the primary impedance of winding **51** and hence the voltage applied to coil **55** at a level where the relay will hold in. This hold in voltage, however, will be low enough such that it will not pull in directly if the switching operation had not been initiated by one of the switches. The circuit for the bleed resistor includes the normally closed contacts **30, 31** for each of the switch stations **64, 65, 66**. Operation of the relay **55** to the open position is effected by opening of any of the switch contacts **30, 31** for any of the positions **64, 65, 66**, opening the circuit of the secondary winding with the bleed resistor and changing the impedance of the primary winding **51** such that the voltage drop across the relay coil **55** will not be sufficient to hold the relay in. The auto transformer and indicating lights for each station, which may or may not be included depending upon what is desired, will normally be connected across the normally opened contacts **30, 32** for each station and hence be in shunt relationship with the secondary winding **52** of the transformer **50**. This unit is a very small transformer which operates to step up the secondary voltage of the coil **52** while the relay coil **55** is normally de-energized. The secondary voltage or the step up voltage from the transformer **68**, while the relay is open or not operated is sufficiently high to light the indicating lamp **75** associated therewith and connected in parallel across transformer winding **68** to give an indication or light when the relay is in an inoperative position. Once the contacts **30, 32** have been closed and the impedance of the primary winding changed to provide pull in voltage to the relay coil **55**, the step up voltage in the transformer **68** will not be sufficient to light the indicating light **75**. With the bleed resistor **40** in the circuit and effecting sufficient change in impedance in the primary and secondary windings **51, 52** of transformer **50** to cause the relay to hold in, this voltage will still remain too low to allow the indicating lamp to be lit. Thus with this arrangement a reverse indication is obtained such that when the relay is energized the indicating light will be off. When the relay is de-energized, the auto transformer will have sufficient voltage step up to light the indicating light associated therewith. It will be recognized that this arrangement may be revised to give indication with the energization of the relay coil merely by operating the load or remote lighting circuit off of a normally closed contact (not shown) of the relay. The present apparatus provides a very simplified means of indicating at any switch station the condition of operation of a remote device through the operation of my improved control apparatus.

It will be further recognized that this indication may also be used in connection with the embodiment shown in Figure 1, if desired, or as previously indicated, separate control contacts on the transformer relay may be included in the indicating circuit.

I claim as my invention:

1. A remote control circuit comprising, relay means including an energizing winding and a contact means associated therewith operative from a first operative position to a second operative position with variation in electrical potential to said winding, circuit means continuously connecting said energizing winding to a source of power, a second winding associated with said first named winding and adapted to control the level of energization with said first named winding, a plurality of remotely positioned switching means each having two circuit closure positions therethrough which are alternately completed, a resistor element, circuit means connecting said plurality of remotely positioned switches such that a series circuit is completed through one position in each of said switching means and to said re-

sistance element and said second named winding, further circuit means connecting said plurality of switching means through said second circuit closure position in a parallel circuit with one another and said second named winding and said resistor element, and load means adapted to be connected to said source of power by said contact means of said relay.

2. A remote control circuit comprising, relay means including an energizing winding and a contact means associated therewith operative from a first operative position to a second operative position with variation in electrical potential to said winding, circuit means continuously connecting said energizing winding to a source of power, a second winding associated with said first named winding and adapted to control the level of energization with said first named winding, a plurality of remotely positioned switching means each having two circuit closure positions therethrough which are alternately completed, a resistor element, circuit means connecting said plurality of remotely positioned switches such that a series circuit is completed through one position in each of said switching means and to said resistance element and said second named winding, further circuit means connecting said plurality of switching means through said second circuit closure position in a parallel circuit with one another and said second named winding and said resistor element, load means adapted to be connected to said source of power by said contact means of said relay, and indicator light means connected to said second named winding and energized therefrom.

3. A remote control circuit comprising, transformer relay means including an energizing winding and a contact means associated therewith operative from operative position to a second operative position with variation in electrical potential to said winding, circuit means continuously connecting said energizing winding to a source of power, a second winding associated with said first named winding and adapted to control the level of energization with said first named winding, a plurality of remotely positioned switching means each having two circuits closure positions therethrough which are alternately completed, a resistor element, circuit means connecting said plurality of remotely positioned switches such that a series circuit is completed through one position in each of said switching means and to said resistance element and said second named winding, further circuit means connecting said plurality of switching means through said second circuit closure position in a parallel circuit with one another and said second named winding and said resistor element, and load means adapted to be connected to said source of power by said contact means of said transformer relay.

4. A remote control circuit comprising relay means including an energizing winding and a contact means associated therewith operative from one operative to a second operative position with variation in electrical potential to said winding, circuit means continuously connecting said energizing winding to a source of power, a second winding associated with said first named winding of the relay means and said source of power and adapted to control the level of energization of the first named winding, a plurality of remotely positioned switching means each having two circuit closure positions therethrough which are alternately completed, a resistor element, circuit means connecting said plurality of remotely positioned switch such that a series circuit is completed through one position in each of said switching means and to said resistance element and said second named winding, further circuit means connecting said plurality of switching means through said second circuit closure position in a parallel circuit with one another and said second named winding and said resistor element, and load means adapted to be connected to said source of power by said contact means of said relay.

5. A remote control circuit comprising, a transformer, a relay including an energizing winding and a contact means associated therewith and operative with variations in electrical potential to said winding, circuit means continuously connecting said energizing winding and a portion of the transformer to a source of power, a plurality of remotely positioned switching means having two circuit closure positions which are alternately completed, a resistor element, circuit means connecting said plurality of switching means such that a series circuit is completed through one of said circuit closure positions for each switch and to said resistor element and another portion of said transformer, further circuit means connecting said plurality of switching means through a second circuit closure position and in parallel relationship with one another and said resistor element and in parallel with said portion of said transformer, and load means adapted to be connected to said source of power by said contact means of said relay.

6. A remote control circuit comprising a transformer, a relay including an energizing winding and a contact means associated therewith and operative with variations in electrical potential to said winding, circuit means continuously connecting said energizing winding and a portion of the transformer to a source of power, a plurality of remotely positioned switching means having two circuit closure positions which are alternately completed, a resistor element, circuit means connecting said plurality of switching means such that a series circuit is completed through one of said circuit closure positions for each switch and to said resistor element and another portion of said transformer, further circuit means connecting said plurality of switching means through a second circuit closure position and in parallel relationship with one another and said resistor elements and in parallel with said another portion of said transformer, and load means adapted to be connected to said source of power by said contact means of said relay, an indicating light means connected to said another portion of said transformer and energized therefrom depending upon the change in impedance of said transformer with the operation of said remote switching means.

7. A remote control lighting circuit comprising, relay means including an energizing winding and a contact means associated therewith, said relay means being operative to operate said contact means with variation in energization of the energizing winding, circuit means connecting said energizing winding to a source of power, a second winding adapted to be coupled to said source of power and operative under short circuit conditions to vary in impedance and vary the energization of the energizing winding associated therewith, a plurality of remotely positioned switches each having a pair of circuit closure positions, a bleed impedance element, circuit means connecting said plurality of switches such that all are serially connected in one circuit closure position with the bleed impedance element and said second winding, further circuit means connecting said plurality of switches in the second circuit closure position in a parallel arrangement to said second named winding to effectively short circuit the same in any of said second named circuit closure positions for any of said plurality of switches, and load means adapted to be connected to the source of power to the contact means of said relay.

8. A remote control lighting circuit comprising, relay means including an energizing winding and a contact means associated therewith, said relay means being operative to operate said contact means with variation in energization of the energizing winding, circuit means connecting said energizing winding to a source of power, a second winding adapted to be coupled to said source of power and operative under short circuit conditions to vary in impedance and vary the energization of the energizing winding associated therewith, a plurality of remotely positioned switches each having a pair of cir-

cuit closure positions, a bleed impedance element, circuit means connecting said plurality of switches such that all are serially connected in one circuit closure position with the bleed impedance element and said second winding, further circuit means connecting said plurality of switches in the second circuit closure position in a parallel arrangement to said second winding to effectively short circuit the same in any of said second named circuit closure positions for any of said plurality of switches, load means adapted to be connected to the source of power to the contact means of said relay, and indicator light means connected to said second named winding and energized selectively in accordance with the variation in impedance in said winding.

9. A remote control circuit comprising, relay means including an energizing winding and a contact means associated therewith, and operative from a first operative position to a second operative position with variation in electrical potential to said winding, circuit means continuously connecting said energizing winding to a source of power, a second winding associated with said first named winding and adapted to control the level of energization with said first named winding, a plurality of remotely positioned switching means each having two circuit closure positions therethrough which are alternately completed, a resistor element, circuit means connecting said plurality of remotely positioned switches such that a series circuit is completed through one position in each of said switching means and to said resistance element and said second named winding, further circuit means connecting said plurality of switching means through said second circuit closure position in a parallel circuit with one another and said second named winding and said resistor element, load means adapted to be connected to said source of power by said contact means of said relay, and an auto transformer means and indicator light connected across the second circuit closure position of at least one of said switching means to be energized from said second named winding.

10. A remote control circuit comprising a transformer, a relay including an energizing winding and a contact means associated therewith and operative with variations in electrical potential to said winding, circuit means continuously connecting said energizing winding and a portion of the transformer to a source of power, a plurality of remotely positioned switching means having two circuit closure positions which are alternately completed, a resistor element, circuit means connecting said plurality of switching means such that a series circuit is completed through one of said circuit closure positions for each switch and to said resistor element and another portion of said transformer, further circuit means connecting said plurality of switching means through a second circuit closure position and in parallel relationship with one another and said resistor elements and in parallel with said another portion of said transformer, and load means adapted to be connected to said source of power by said contact means of said relay, an auto transformer means connected to at least one of said switching means in shunt relation therethrough with said second circuit closure position and in parallel with said another portion of said transformer, and indicating light means connected to said auto transformer and energized therefrom.

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